

‘Herophilus and Erasistratus on the *hēgemonikon*’

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Introduction

In Alexandria at some point in the early third century BC, Herophilus of Chalcedon identified the nerves as a distinct system within the body, traced their origins to the brain, and recognised their role in transmitting sensation and voluntary motion. His discovery was based on dissection and vivisection, not only of animals, but also of human beings. Herophilus’ younger contemporary Erasistratus also integrated these findings into his rather bolder physiology. The implications of this discovery were of course wide-ranging. From a modern perspective, it is now widely celebrated as having established, for the first time on something like a scientific basis, that the brain has more or less the functions that we now ascribe to it. Likewise, in antiquity, Galen relied heavily on Herophilus’ discovery in his proof that the rational soul is located in the brain. As we shall see, it also had an impact on Stoic psychology. What exactly Herophilus and Erasistratus saw as its implications, however, is a different question, and the difficulties in answering it are considerable given the state of the evidence.¹

The Aëtian *Placita* tradition reports that Herophilus and Erasistratus each had answers to the question of the location of the *hēgemonikon*:²

On the *hēgemonikon*. Plato and Democritus [say that it is] in the whole head. Strato [says that it is] in the ‘mid-brow’. Erasistratus [says that it is] in the membrane of the brain, which he calls the *epikranis*. Herophilus [says that it is] in the cavity of the brain, which is also its base. ... etc.

The membrane mentioned in the Erasistratean entry presumably refers to both the pia and dura mater together, which he certainly distinguished.³ In the Herophilean report, the ‘base’ of the brain refers to the cerebellum. These testimonia have been highly influential in recent assessments of the broader theoretical contexts in which the newly discovered nervous system played a role for these doctors.⁴

¹ The fragments of Herophilus and Erasistratus are collected in von Staden 1989 and Garofalo 1988 respectively.

² Ps.-Plut. *Plac.* 4.5, Περὶ τοῦ ἡγεμονικοῦ. (1) Πλάτων Δημόκριτος ἐν ὅλῃ τῇ κεφαλῇ. (2) Στράτων ἐν μεσοφρύφῳ. (3) Ἐρασίστρατος περὶ τὴν μήνιγγα τοῦ ἐγκεφάλου, ἣν ἐπικρανίδα λέγει. (4) Ἡρόφιλος ἐν τῇ τοῦ ἐγκεφάλου κοιλίᾳ, ἣτις ἐστὶ καὶ βάσις ... See too Theodoret 5.22, ὅσα δὲ καὶ περὶ τῆς τοῦ ἡγεμονικοῦ χώρας διηρέθησαν πρὸς ἀλλήλους ῥάδιον διαγινῶναι. (1) Ἴπποκράτης μὲν γὰρ καὶ Δημόκριτος καὶ Πλάτων ἐν ἐγκεφάλῳ τοῦτο ἰδρῦσθαι εἰρήκασιν. (2) ὁ δὲ Στράτων ἐν μεσοφρύφῳ. (3) Ἐρασίστρατος δὲ ὁ ἰατρός περὶ τὴν τοῦ ἐγκεφάλου μήνιγγα, ἣν καὶ ἐπικρανίδα λέγει. (4) Ἡρόφιλος δὲ ἐν τῇ τοῦ ἐγκεφάλου κοιλίᾳ ... Tert. *DA* 15.5 and *Cael. Aur. Cel. Pass.* 1.8.53 offer additional witnesses to the *Placita* reports. For a detailed overview of the *Placita* tradition on this question, see Mansfeld (1990), 3092-108.

³ See below on Erasistratus’ anatomy of the brain. The term ἐπικρανίς attributed to Erasistratus here has been suspected by some, but I do not think that the emendation suggested by Diels 1879: 207-9, is warranted.

⁴ E.g. von Staden 2000: 87, ‘Herophilus’ remarkable anatomical explorations ... not only allowed him to confirm that the brain is the centre of all psychic activity, as several predecessors had claimed, but also to specify more precisely than any precursor the location of the soul’s central “ruling part”; Cambiano 1999: 601, ‘Thanks to this (dissection) Herophilus was able to observe the ventricles of the brain and to show in one of these the site of the central psychic organ’; Solmsen 1961: 192-3, ‘[Erasistratus] evidently, like Herophilus, placed the *hegemonikon* or organ of thought in the cerebellum.’

In this paper, however, I shall argue that the *Placita* testimonia on Herophilus and Erasistratus are significantly misleading in a number of ways. A closer look at the remaining evidence reveals a rather more complicated picture, and there are indications that their particular concerns were in some respects different from what has often been assumed. Specifically, I shall try to show that neither doctor singled out the brain or its meninges as the location of the *hēgemonikon*, as the *Placita* testimonia tell us, and that in fact they did not have a theory of a *hēgemonikon* at all. The functioning of the human body for them involved complex processes spanning multiple organs and mediated by multiple fluids. Voluntary motion and sensation were only two among a wider array of fundamental physiological functions; other, no less fundamental, functions were also closely associated with the heart. Nor do mental phenomena such as rational thought, memory, emotions, etc., appear to have been associated with the brain or its meninges, or indeed any bodily organ. The functions which were associated with the nerves (and through them the brain or its meninges) were all thought to be mediated by the physical substance of *pneuma*, but there is no sign that Herophilus and Erasistratus attempted to account also for other mental functions. Such functions, I shall suggest, may have been thought to belong properly to the soul, and as such were of questionable relevance to the medical art, at least according to Herophilus and Erasistratus. The reports on their views regarding the *hēgemonikon* will have arisen, not from their original writings, but from Chrysippus' response to the physiology of the nervous system in his treatise *On the Soul*. Chrysippus will have addressed the nervous system only insofar as it had a bearing on the question of the location of the *hēgemonikon*. The fact that this Stoicising version of Herophilus and Erasistratus' views has in some ways been taken at face value is perhaps also connected to a tendency to assimilate early Alexandrian neurology too readily to a modern understanding of the brain.

I shall begin by examining the evidence we have for Herophilus' and Erasistratus' analysis of the brain and nervous system separately, before attempting to assess the general character of their theories and their principal concerns. I shall also consider the degree to which they believed that the inquiry into the soul and its interaction with the body properly belonged to the medical art at all. The subsequent section will take a close look at how Chrysippus responded to the physiology of the nervous system in his treatise *On the Soul*, and will argue that his discussion is a plausible source for the erroneous attribution to Herophilus and Erasistratus of opinions on the location of the *hēgemonikon*. Finally, I shall consider how a similar fate may have befallen Strato of Lampsacus in regard to his views on the same subject.

Herophilus

Studies by Friedrich Solmsen and Heinrich von Staden have put it beyond reasonable doubt that Herophilus was indeed the first to isolate the nerves as a distinct anatomical structure within the body, and to ascertain their function in mediating both sensation and voluntary motion.⁵ He regarded the nerves, however, as basically similar to the various cords, tendons and ligaments for which the term *neuron* had previously been used, but differentiated them by their sensory and motor function. This is attested for example by Rufus of Ephesus: 'according to Herophilus, some *neura* are voluntary <and sensory?>, which grow from the brain and spinal marrow, while some grow from bone to bone, others from muscle to muscle,

⁵ See esp. Solmsen 1961 and von Staden 1989: 159-60.

which also bind together the joints'.⁶ Galen refers to the same division of types of *neuron*, where he probably has Herophilus in mind: 'but if you want to confuse the names, as most have done since Hippocrates' time, call them all *neura* but say that there is a three-fold distinction among them, those from the brain and spinal cord being sensory and voluntary, those without sensation being ligamentous, and third, in addition to these, are those that grow from the muscles as they become cord-like'.⁷ The focus on specifically *voluntary* motion, that is, motion *κατὰ προαίρεσιν* (literally 'in accordance with choice') stems from Herophilus' recognition, as we shall see, of the separate, *natural* motion involved in such phenomena as the arterial pulse, which is not under our control.⁸

As for the brain, Herophilus distinguished its four ventricles, and believed that the one in the cerebellum has greatest significance: 'Those who consider this cavity [sc. the fornix] to be a fourth ventricle say that, of all the ventricles in the entire brain, it is most dominant. Herophilus, however, seems to think that not this ventricle, but the one in the cerebellum (*parenkephalis*), is more dominant'.⁹ This of course immediately recalls the *Placita* reports which have Herophilus locating the *hēgemonikon* 'in the ventricle of the brain, which is its base'. Nonetheless, Galen is not suggesting here that the ventricle in the cerebellum is the most important part of the body, but only that it is more important than the brain's other ventricles.

It is a crucial point for understanding the subsequent debate that, as noted, Herophilus used the term *neuron*, not only for what we would recognise as nerves, but also for the various other 'cord-like' structures in the body, such as tendons and ligaments. The confusion this has caused is certainly regrettable, but Herophilus may well have had good reasons for using the same term for all such structures. Direct continuity between the nerves, tendons and ligaments seems to have been envisioned. Galen describes the composition of such structures as follows: 'the nerve in each muscle separates into fibres and mixes and intertwines with the fibres from the ligaments, and then a single nerve-like structure, the product of their union, grows out from the body of the muscle, the so-called tendon'.¹⁰ It seems plausible that this idea of tendons being made of nerve fibres fused together with ligamentous tissue could, in its essentials, go back to Herophilus. Galen attributes to him the concept of a 'nerve-like' or perhaps better '*tendon-like class*' (τὸ νευρῶδες γένος) of bodily parts, which included the nerves, ligaments and tendons: all were of the same type.¹¹ In what follows, I shall reserve the term 'nerves' for what modern biology would recognise as nerves; otherwise, I shall speak of *neura* in general.

⁶ Herophilus T81 von Staden = Rufus of Ephesus, *Anatomy of the parts of the body* 75 [pp. 184-185 Daremberg-Ruelle], *κατὰ δὲ τὸν Ἡρόφιλον ἃ μὲν ἐστὶ προαιρετικά <καὶ αἰσθητικά (?)>, ἃ καὶ ἔχει τὴν ἔκφυσιν ἀπὸ τοῦ ἐγκεφάλου καὶ ωτιαίου μυελοῦ, καὶ ἃ μὲν ἀπὸ ὀστοῦ εἰς ὀστοῦν ἐμφύεται, ἃ δὲ ἀπὸ μῦος εἰς μῦν, ἃ καὶ συνδεῖ τὰ ἄρθρα.*

⁷ Gal. *PHP* 1.9.10 [p. 96 de Lacy], εἰ δὲ καὶ συγγεῖν βούλοιο τὰς προσηγορίας ὡς οἱ πλεῖστοι τῶν μεθ' Ἱπποκράτη, κάλει μὲν ἅπαντα νεῦρα, διαφορὰς δὲ ἐν αὐτοῖς λέγε τριτάτας, αἰσθητικὰ μὲν καὶ προαιρετικὰ τὰ ἐξ ἐγκεφάλου καὶ ωτιαίου πεφυκότα, συνδετικὰ δὲ τὰ ἀναίσθητα, καὶ τρίτα ἔτι πρὸς τούτοις τὰ ἐκ τῶν μῦων ἀπνευρουμένων φόμενα, after de Lacy.

⁸ A similar terminological distinction is made, for example, by Aristotle, at *PA* 657a 37-b 1, on non-voluntary blinking to prevent things getting in the eyes: καὶ τοῦτο οὐκ ἐκ προαιρέσεως, ἀλλ' ἡ φύσις ἐποίησε.

⁹ T78 [T138] von Staden = Galen, *De Usu Partium* 8.11 [i 484 Helmreich], καὶ οἷς γε τετάρτη τις αὐτῆ κοιλία νενόμισται, κυριωτάτην εἶναι φασιν αὐτὴν ἀπασῶν τῶν καθ' ὄλον τὸν ἐγκέφαλον. Ἡρόφιλος μὴν οὐ ταύτην, ἀλλὰ τὴν ἐν τῇ παρεγκεφαλίδι κυριωτέραν ἔοικεν ὑπολαμβάνειν.

¹⁰ *PHP* 1.10.14 [p. 98 de Lacy], λυόμενον γὰρ εἰς ἴνας ἐν ἐκάστῳ μὲν τὸ νεῦρον ἀναμίγνυται τε καὶ διαπλέκεται ταῖς ἐκ τῶν συνδέσμων ἰσίν, εἴτα ἐξ ἁμφοῖν ἓν τι νευρῶδες σῶμα γεννηθὲν ἐκφύεται τοῦ σώματος <τοῦ> μῦος ὁ προσαγορευόμενος τένων, trans. de Lacy.

¹¹ See von Staden 1989: 255-6.

A key issue here is how Herophilus analysed the nervous system's basic functions of mediating perception and voluntary motion in the broader context of human physiology. How exactly did these fit in with the body's other functions? According to an offhand remark made by Galen, Herophilus believed that there are four capacities (δυνάμεις) which regulate living things:¹²

Then they (i.e. Archigenes and his followers) inquire which cause moves the arteries, and they omit nothing Herophilus wrote on this; but when his theories make a difference for the practice of the art, they no longer mention at all whether what Herophilus wrote is correct or incorrect. For God's sake, wouldn't it be much better not to inquire about the fact that four capacities were said by Herophilus to govern living beings, or to argue bitterly and to speak against him concerning those things at least, but rather, if they did wish to revile and refute him for talking idle nonsense, to mention such of his views as are clearly in conflict with what is evident?

This specific number of four is striking. Unfortunately, however, only one of these capacities is clearly identified in our sources. The passage quoted is important for context: the physician Archigenes and his followers¹³ are being criticised by Galen for getting embroiled in tangential and arbitrarily chosen doctrinal disputes with Herophilus over pulsation. Galen makes it clear that they had attacked Herophilus' basic analysis of four capacities *specifically* in relation to the question of what causes arterial motion. Our evidence, though scanty, offers some indication of why they should have done so. Herophilus believed that the arteries, being continuous with the heart, dilate thanks to a capacity which flows from it throughout their coats.¹⁴ But the Aëtian *Placita* identifies in Herophilus' theory a basic 'motive capacity' (κινητικὴ δύναμις) which is responsible not only for arterial motion, but also for the motion associated with *neura* and muscles; to quote: 'Herophilus recognises a motive capacity in bodies, in the *neura*, arteries and muscles'.¹⁵ The hypothesis that this motive capacity represented one of the four *fundamental* capacities would also immediately explain why Archigenes, in the restricted context of arterial motion, should have discussed the general, fourfold division of capacities which regulate living things. Thus Archigenes' discussion will have begun from Herophilus' positing a fundamental motive capacity as part of his explanation of arterial motion, and moved from there to criticism of his overall account of the

¹² T184 von Staden, after von Staden, εἶτα τίς μὲν ἢ κινουσα τὰς ἀρτηρίας αἰτία ζητοῦσι καὶ τῶν εἰς τοῦθ' Ἡροφίλῳ γεγραμμένων οὐδὲν παραλείπουσι, τῶν δ' εἰς τὰ ἔργα τῆς τέχνης διαφερόντων θεωρημάτων, οὐτ' εἰ καλῶς οὐτ' εἰ μὴ καλῶς ἔγραψεν Ἡρόφιλος, οὐδενὸς ἔτι μέμνηται· ὃ πρὸς τῶν θεῶν, οὐ πολλὸν μέντοι βέλτιον ἦν μὴ περὶ τοῦ τέτταρας ὕφ' Ἡροφίλου λέγεσθαι τὰς διοικούσας τὰ ζῶα δυνάμεις ζητεῖν, μηδὲ πικρῶς ἐρίξειν τε καὶ ἀντιλέγειν αὐτῷ περὶ γε τούτων, ἀλλ' εἴπερ ἐβούλοντο καταβάλλειν τε καὶ διεξελέγξαι αὐτὸν εἰκῆ ληροῦντα, τῶν τοιούτων αὐτοῦ μνημονεύειν, ἃ φανερώς τοῖς ἐναργέσι μάχεται; Soranus independently uses the same terminology in another Herophilean testimonium, in a way which tends to confirm this analysis of regulating faculties as a core aspect of Herophilus' theory, at T193 von Staden: 'In his *Midwifery* Herophilus says that the uterus is woven from the same things as the other parts and regulated by the same faculties (ὕπὸ τῶν αὐτῶν δυνάμεων διοικεῖσθαι)'. Cf. also Anon. Lond. xxii 36-xxii 49.

¹³ For the identification of Galen's opponents as the followers of Archigenes, see earlier at *Dig. Puls.* 2.2 [8.853 K.], where Archigenes is named as the doctor who states that the pulse of a child is small, like those later at T184 von Staden just before the passage quoted.

¹⁴ T144 von Staden, τοῖς δὲ περὶ τὸν Ἡρόφιλον ἀρέσκει τὰς ἀρτηρίας συνεχεῖς οὐσας τῇ καρδίᾳ διὰ τῶν χιτώνων ἐπιρρέουσιν ἔχειν τὴν παρ' αὐτοῖς δύναμιν, ἣ χρώμεναι παραπλησίως αὐτῇ τῇ καρδίᾳ διαστελλόμεναι μὲν ἔλκουσι πανταχόθεν, ὅθεν ἂν δύνονται, τὸ πληρώσον αὐτῶν τὴν διαστολήν. See also T145a, T155 von Staden, with von Staden 1989: 270-1. Herophilus' teacher Praxagoras, by contrast, believed that the arteries themselves had their own innate and independent faculty to pulsate: Praxagoras fr. 9-10 Lewis = fr. 28 Steckerl = Gal. *Diff. Puls.* viii 702 K. and *PHP* 6.7 [p. 404-6 de Lacy]; see Lewis 2016: 222-9 for discussion.

¹⁵ T143b von Staden, Ἡρόφιλος δὲ δύναμιν ἀπολείπει περὶ τὰ σώματα κινητικὴν ἐν νεύροις καὶ ἐν ἀρτηρίαις καὶ ἐν μυσίν.

four capacities. It is easy to see why Galen might have objected to Archigenes' misguided choice of target, especially since, from Galen's point of view, there were more glaringly mistaken aspects of Herophilus' doctrine which Archigenes apparently left untouched – such as his refusal to acknowledge that children have a small pulse, which is the subject of the discussion in the immediate context of Galen's complaint here.

So it seems clear that a motive capacity was one of the four fundamental capacities in Herophilus' analysis of human functioning. However, Herophilus introduced a subdivision, positing different kinds of motion in the animal body, transmitted by different means. Within the motive capacity, he distinguished two types: voluntary (or *prohaeretic*) motion, and natural motion. Natural motion included arterial pulsation, whereas voluntary motion was carried out by the nerves (and through them the ligaments, tendons, and muscles). This opposition between natural and voluntary motion is clearly set out in another Herophilean testimony. According to the author of a *Synopsis on Pulses*, possibly Rufus of Ephesus, Herophilus believed that:¹⁶

... the pulse at all times attends us involuntarily (ἀπροαιρέτως), since it also exists naturally (φυσικῶς), whereas the others (i.e. palpitation, spasm, tremor) obey our volition (προαιρέσει), when the parts are pushed outwards often and depressed.

Hence, in identifying the nerves as mediators only of *voluntary* motor function, Herophilus was forced to offer a different account of the non-voluntary motions in the body: as we have seen, the pulsation of the heart and arteries was due to their own innate, 'natural' faculty.

According to Herophilus, voluntary motion functions by means of the pneuma that flows through the nervous system.¹⁷ This pneuma is derived ultimately from respiration, as confirmed by a chapter from Aëtius' *Placita* on whether the foetus is an animal:¹⁸

... Herophilus recognises only natural motion (κίνησιν φυσικήν) in foetuses, not pneumatic. (He thinks that) the nerves are responsible for motion; and that (foetuses) become animals at the point when, having been brought forth, they take in some air.

Foetuses cannot be classed as animals since they possess only natural motion, and not the pneumatic motion that is taken to characterise this class of living being. Given Herophilus' distinction between natural motion and voluntary motion elsewhere, it makes excellent sense to identify this pneumatic motion with voluntary motion, which was certainly transmitted by the nerves, and to take this voluntary type of motion as the criterion that separates animals

¹⁶ T149 von Staden = Rufus (?), *Synopsis on Pulses* 2 [p. 221 Daremberg-Ruelle], καὶ τὸν μὲν σφυγμὸν ἀπροαιρέτως ἡμῖν πάντοτε παρακολουθεῖν, ἐπεὶ καὶ φυσικῶς ὑπάρχει, ταῦτα δὲ εἶναι καὶ ἐν τῇ ἡμετέρᾳ προαιρέσει, ἀποπιεσθέντων πολλάκις καὶ βαρυνθέντων τῶν μερῶν.

¹⁷ Von Staden 1989: 257, and 2000: 89, is doubtful concerning the presence of pneuma in the motor nerves, based on a passage in T141 von Staden = Gal. *Trem. Palp.* 5 [vii 605-6 K.], where Galen criticises Herophilus for not recognising that 'the body of the nerves is not itself the cause of motion but rather its instrument, whereas its moving cause is the faculty which extends through the nerves. Here I reproach him for not having distinguished faculty from instrument'. Von Staden argues at 1989: 257, that '[i]f Galen's criticism is accepted as valid, Herophilus attributed voluntary motion to the motor nerves, ligaments, tendons, and muscles ..., but did not introduce another faculty or medium such as motor pneuma'. But this rests on a conflation in what von Staden refers to as the '*faculty or medium* such as motor pneuma': while pneuma can be a medium, it cannot be a faculty. So Galen cannot have been talking about pneuma at all in Herophilus' account here, its absence or otherwise, and therefore this passage does nothing to cast doubt on the conclusion drawn from other testimonia that Herophilus' motor nerves contain pneuma.

¹⁸ T202 von Staden = Aët. *Plac.* 5.15.5, εἰ τὸ ἔμβρυον ζῶον· ... Ἡρόφιλος κίνησιν ἀπολείπει φυσικήν τοῖς ἐμβρύοις, οὐ πνευματικήν· τῆς δὲ κινήσεως αἴτια νεῦρα· τότε δὲ ζῶα γίνεσθαι, ὅταν προχυθέντα προσλάβῃ τι τοῦ ἀέρος.

from lower classes of living being.¹⁹ The point here must be that although foetuses have a nervous system, it is not active since it has not yet been filled by the pneuma drawn from respiration, which first occurs at birth. Hence they cannot move themselves deliberately, as animals do, yet they certainly possess the natural motion of pulsation, and presumably the various other motions which foetuses can be observed to make *in utero* – for Herophilus, these must have been involuntary.

For present purposes, the main thing to observe is that the motive capacity, present only in the arteries, *neura* and muscles, was subdivided into two types of motion, each with a distinct source: voluntary motions, mediated by the nervous system, originate in the brain, while natural motions begin in the heart.

As noted, we have no direct evidence naming the other three fundamental capacities in Herophilus' physiology, and any suggestions must remain entirely speculative. Nevertheless, given that Herophilus assigned perceptual function as well as voluntary motion to the nervous system, the inclusion of a fundamental *perceptive* capacity in his system looks like an obvious possibility. Its origin he would presumably have located in the brain, insofar as the nerves issue from there. Similarly, the fundamental importance of the digestive process to medical accounts of human physiology and pathology might recommend a nutritive capacity as another of Herophilus' four. Possible connections with Aristotelian biology, according to which living creatures are characterised principally by nutritive, locomotive, perceptive and intellective capacities, may offer further support for these particular suggestions. Whatever the case, however, the fundamental importance of the heart must have been recognised. The Anonymus Londinensis papyrus reports that Herophilus believed nutrition to occur by means of blood transmitted mostly through the arteries and to a lesser degree through the veins.²⁰ For Herophilus, the arterial system, and possibly also the venous, originated in the heart.²¹ The importance, especially diagnostic, which the pulse held in his medical system would certainly have emphasised the significance of the heart.²²

It is also worth emphasising that Herophilus undertook a comparative anatomy of humans with various animal species. In fact, it seems likely that the availability of human bodies will have been highly restricted, and the majority of his dissections may have been carried out on animals.²³ But any phenomena connected with the nervous system that Herophilus might have observed in his dissection and vivisection of human beings would have been equally observable in animals. The nervous system's responsibility for voluntary motion and perception, each transmitted by pneuma, will have been the same across human

¹⁹ Others have suggested (cf. von Staden 1989: 257-8), on the other hand, that 'pneumatic motion' might alternatively refer merely to respiration, but this ignores Herophilus' attested distinction between types of motion. Nor does it make sense of the argument, since it would no longer be clear why foetuses should be disqualified as animals: as Aristotle had observed, not all animals respire (e.g. *Resp.* 1, 470b 9-10). For deliberate motion as a unique capacity of animals, see e.g. *Pl. Tim.* 77b-c; *Arist. DA* 2.3, 414a 29-b 2; *ibid.* 3.9, 432b 8-19; *Gal. Nat. Fac.* 1.1 [ii 1 K.]. Herophilus believed that the lungs do not themselves partake of the motive capacity, but merely 'grasp at' dilation and contraction, according to T143 von Staden = *Aët. Plac.* 4.22.3.

²⁰ T146 von Staden = *Anon. Lond.* xxviii 46-49 [p. 66 Manetti], ὁ μέντοι γε Ἡρόφιλος ἐναντίως διείλη|ψε[v]· ὀξετα[ι] γ(ἄρ) πλείονα μ(έν) γί(νεσ)θ(αι) ἀνάδοσιν | ἐν ταῖς ἀρτηρίαις, ἥσσονα δὲ ἐν | ταῖς φλεβῶν διὰ δύο ταῦτ[α]. ('Herophilus, however, has taken the opposite view. For he thinks greater distribution (of nourishment) occurs through the arteries and less through the veins for the following two reasons').

²¹ Galen reports that Herophilus felt at a loss as to which organ should come first in his exposition of the venous system (T115 von Staden = *Gal. PHP* 6.5.22 [*CMG* V 4, 1, 2 p. 392 de Lacy]).

²² See von Staden 1989: 262-88 for Herophilus' views on the pulse.

²³ See von Staden 1989: 140 and n. 3, 158-9, 179: Herophilus regularly referred to animal anatomy alongside that of humans, and his anatomy of the *rete mirabile* must be based on an ungulate.

and animal species. It is not surprising, then, that our evidence shows no sign of any interest on Herophilus' part in the physiology of higher rational functions, such as thinking, memory, etc.

Herophilus' conception of the functioning of animals was a highly complex one, comprising processes which spanned multiple organs and vessel systems. There were four fundamental capacities, one of which was the motive. The motive capacity itself encompassed different forms of motion: 'natural' motion, such as the arterial pulse, had its origins in part of the heart, while voluntary motion was mediated by nerves arising from within the brain. But these major organs played only a partial role within system-wide processes. The lungs and thorax, for example, were responsible for drawing in the pneuma and distributing it to the nervous system, which then transmitted sensation and voluntary motion. The media by which these capacities functioned varied considerably too: fluid substances, such as blood and pneuma, were required for mediating processes involved in nutrition, voluntary motion and sensation, while other types of bodily motion could be transmitted directly, through a natural capacity, to solid anatomical structures such as the arteries. These various processes were clearly integrated, with the different systems closely interacting, and their malfunction of course led to the pathological phenomena which it was the doctor's job to correct.

Erasistratus

Erasistratus' physiology was based on the interaction between three principal systems in the body, the arterial, venous and nervous.²⁴ Each had its own origin, proper fluid content, and distinct functions: the arterial system originated in the heart's left ventricle and naturally contained only 'vital' pneuma; the venous originated in the heart's right ventricle and naturally contained only blood; and the nervous system had its source apparently in the brain's meninges, and contained only 'psychic' pneuma. The arterial system was responsible for basic physiological functions such as digestion, the venous system for transmitting nutriment, and the nervous system for transmitting voluntary motion and perception, just as Herophilus believed. These three systems, which Erasistratus apparently referred to as a *triplokia*, or 'threefold network', permeated the entire living body, while the remaining organs, bones, etc., formed its basic structure, to which Erasistratus gave the general term '*parenchyma* of nutriment'.

For Erasistratus, as for Herophilus, the pneuma which is contained in the arterial and nervous systems is ultimately derived from breathing. According to his physiology, air or pneuma passes into the lungs and from there into the heart; then the heart pumps the pneuma from its left ventricle throughout the arterial system, including the carotid arteries which lead to the head. Some of this 'vital' pneuma thus makes its way into the nerves and there becomes the 'psychic' pneuma with which we sense and move ourselves voluntarily. According to Galen, Erasistratus believed that it is specifically in the brain's meninges that the transfer of pneuma takes place between the ends of the arteries and the beginnings of the nerves:²⁵

²⁴ For Erasistratus' physiology, see esp. Lonie 1964; Harris 1973: 195-233; Garofalo 1988: 22-58; Vallance 1990: 62-79; Vegetti 1998; von Staden 1997 and 2000: 92-6; and Leith 2015a.

²⁵ Fr. 112 Garofalo = Gal. *Ut. Resp.*, after Furley, ἀλλ' οὐδ' ἐκ τῆς εἰσπνοῆς ὁμοίως οἱ περὶ τὸν Ἐρασίστρατον τοῖς <περὶ τὸν> Ἱπποκράτην τρέφεσθαι φασι τὸ ψυχικὸν πνεῦμα· τοῖς μὲν γὰρ ἐκ καρδίας διὰ τῶν ἀρτηριῶν ἐπὶ τὰς μῆνιγγας, τοῖς δὲ εὐθὺς διὰ τῶν ῥινῶν εἰς τὰς κατὰ τὸν ἐγκέφαλον κοιλίας ἔρχεσθαι τὸ πνεῦμα δοκεῖ.

But Erasistratus and his followers do not say that the psychic pneuma is nourished by what is breathed in, in the same way as do Hippocrates and his followers. For to the former the pneuma appears to come from the heart through the arteries to the meninges (of the brain), to the latter, to come directly through the nostrils into the ventricles in the brain.

It is worth comparing Aristotle's contrast between the presence of blood vessels in the brain's meninx and their absence in the brain itself.²⁶ Galen also specifies that, in Erasistratus' view, loss of motor function is caused by damage to the brain's meninges, rather than to any underlying structures.²⁷ Likewise Erasistratus maintained that phrenitis and lethargy, which involve impairment to motor and sensory capacities, are affections of the brain's meninges, plausibly again because they involve blockages or other interferences with the normal transmission of pneuma there.²⁸ All this obviously also aligns well with the *Placita* testimony that he located the *hēgemonikon* in the meninges.

So it may be that, for Erasistratus, the brain itself contributed little to perceptual and motor function. This would also conform easily to his conception of brain matter as a *parenchyma* of nutriment. This *parenchyma* is a sort of fleshy or fatty filling found in between, and distinct from, the three primary vessel systems.²⁹ Elsewhere in Erasistratus' physiology, the *parenchyma* which forms other organs plays no active role, merely providing a structure for the various vessels of the body, and acting as a container or conduit for the different fluids passing through it. Hence the brain matter itself is not part of the three main functional systems. Such a conception of the brain should warn against taking Erasistratus' views as anticipating in any straightforward sense the findings of modern neurology.

However, Galen on a different occasion claims that Erasistratus had in fact revised his earlier view that the nerves issue from the meninges, and late in life came to see the brain

²⁶ Arist. *HA* 1.16, 495a 4-9, ἀναιμος δ' ὁ ἐγκέφαλος ἅπασι, καὶ οὐδεμίαν ἔχων ἐν αὐτῷ φλέβα ... ἡ δὲ περὶ αὐτὸν μῆνιγξ φλεβώδης· ἔστι δ' ἡ μῆνιγξ ὑμὴν δερματικὸς ὁ περιέχων τὸν ἐγκέφαλον ('In all animals the brain is bloodless; there is not a single blood vessel in it ... The membrane which surrounds it is patterned with blood vessels: this is the skin-like one which surrounds the brain', trans. Peck).

²⁷ Fr. 42 Garofalo = Gal. *PHP* 7.3.32-33 (v 609-10 K. = p. 446 de Lacy) καὶ τις ἄλλος εἷς ἀζυγῆς ἐμβάλλει τῇ πρώτῃ γενέσει τοῦ νωτιαίου, καθ' ὃ μέρος μάλιστα τῆς παχείας μῆνιγγος τρωθείσης ὁ πόρος ὅλος γίνεταί γυμνὸς ἅμα τῷ πέρατι τῆς ὀπισθεν ἐγκεφάλου κοιλίας, ὅπερ οὐχ ἦκιστα τὸν Ἐρασίστρατον ἠπάτησεν, ὡς οἰηθῆναι διὰ τὴν τῆς μῆνιγγος τρώσιν ἀκίνητον αὐτίκα γίνεσθαι τὸ ζῶον· ἐώρα γὰρ ἐπὶ τῶν κατὰ τὸν πρῶτον σπόνδυλον τιτρωσκομένων βοῶν ἅμα τῷ διαιρεθῆναι τὴν μῆνιγγα ἀκίνητον αὐτίκα τὸ ζῶον γινόμενον. ἀλλ' οὐ τῷ πάθει τῆς μῆνιγγος, ἀλλὰ τῷ γυμνοῦσθαι τὴν ὀπίσω κοιλίαν γίνεταί τοῦτο ('Another passage, which is single and unpaired, empties into the first beginning of the spinal medulla; and here especially, when the dura mater is cut at this point, the entire passage is laid bare, along with the end of the posterior ventricle of the brain. This was not the least reason why Erasistratus mistakenly believed that the animal immediately becomes motionless when the meninx is cut; for he saw that oxen wounded at the first vertebra become motionless as soon as the meninx is severed. But this results not from the injury to the meninx but from the exposure of the posterior ventricle', trans. de Lacy).

²⁸ Fr. 176-7 Garofalo = Anon. Paris. *Morb. Ac. et Chron.* 1.1.1, 2.1.1 [pp. 2, 10 Garofalo].

²⁹ Fr. 86 Garofalo = ps.-Gal. *Int.* 9.3-4 [14.697-8 K. = p. 21 Petit], καὶ Ἐρασίστρατος δὲ ὡς ἀρχὰς καὶ στοιχεῖα τοῦ ὅλου σώματος ὑποτιθέμενος τὴν τριπλοκίαν (οἱ τριπλέκειαν) τῶν ἀγγείων, νεύρα καὶ φλέβας καὶ ἀρτηρίας ... πολλὰ δὲ καὶ ἄλλα σωμάτων εἶδη εὕρισκεται, οὐκ ἐκ τῆς τριπλοκίας (οἱ τριπλεκειάς) συγκείμενα, οἷον εὐθὺς ὁ ἐγκέφαλος καὶ ὁ μυελὸς καὶ πάντα τὰ ὀστέα. τὸν μὲν οὖν ἐγκέφαλον ἢ τὸν μυελὸν παρέγγυμα τροφῆς τολμᾷ λέγειν, ὡς τὴν πιμελὴν, καὶ τοῦ ἥπατος καὶ σπληνὸς καὶ πνεύμονος τὴν σύστασιν ('Erasistratus posited as principles and elements of the whole body the triple web of vessels, that is the nerves, veins and arteries ... And many other kinds of bodies are found which are not composed of the triple web, such as, for example, the brain, the marrow, and all the bones. So he dared to call the brain and marrow a *parenchyma* of nutriment, just like fat and the substance of the liver, spleen and lungs').

itself as their source. Galen makes it clear elsewhere that his claim is a controversial interpretation of Erasistratus' position that he himself developed.³⁰

Erasistratus, who for a long time saw only the outer part of the nerve, (the part) that comes from the dura mater, thought that the whole nerve grows from that source, and most of his writings are full of statements that the nerves grow from the meninx that encloses the brain. But when, late in life and at leisure to devote himself entirely to the study of the art, he performed his dissections with greater care, he recognised also that the heart-wood,³¹ so to speak, of the nerves grows from the brain. He writes as follows: "We viewed the structure of the cerebrum, and it was bipartite, as in the other animals, and there were ventricles lying there, elongated in form. The ventricles were united by a perforation at the point of contact of the parts. From this point a passage led to the so-called cerebellum, where there was another small ventricle. Each of the parts had been partitioned off by the meninges. For the cerebellum had been partitioned off by itself, and also the cerebrum, which is similar to the jejunum and has many folds; and the cerebellum, even more than the cerebrum, was provided with many varied convolutions. So the observer learns from these that as it is in the other animals – deer, hare and any other that far excels the rest in running being well provided with the muscles and sinews useful for this activity –, so in man, since he is far superior to the other animals in thinking, this (member) is large and has many folds. And the outgrowths of the nerves were all from the brain; and speaking generally the brain appears to be the source of the nerves in the body. For the sensation that comes from the nostrils passed to this through apertures, and also the sensations that come from the ears. And outgrowths from the brain went also to the tongue and the eyes." In these words Erasistratus admits that he then saw clearly a thing that he had not known earlier, that each nerve grows from the brain. And he wrote accurately about its four ventricles, which he had also failed to see the year before.

Now in the quotation Erasistratus certainly speaks of the nature of the brain in relation to humans' superior capacity for thinking (διανοεῖσθαι), and refers to the outgrowths of the

³⁰ Fr. 289 Garofalo = Gal. *PHP* 7.3.6-12 [v 602-4 K. = pp. 440-2 de Lacy], after de Lacy: 'Ερασίστρατος δ' ἄχρι πολλοῦ τὴν ἐξῶθεν μοῖραν ὀρῶν μόνην τοῦ νεύρου τὴν ἀπὸ τῆς παχείας μήνιγγος ὀρμωμένην, ἀπ' ἐκείνης ὧτε πεφυκέναι σύμπαν τὸ νεῦρον καὶ μεστὰ γε τὰ πλεῖστα τούτου τῶν συγγραμμάτων ἐστὶν ἀπὸ τῆς περιεχούσης τὸν ἐγκέφαλον μήνιγγος πεφυκέναι φάσκοντος τὰ νεῦρα. ἀλλ' ὅτε πρεσβύτης ὢν ἤδη καὶ σχολὴν ἄγων μόνοις τοῖς τῆς τέχνης θεωρήμασιν ἀκριβεστέρας ἐποιεῖτο τὰς ἀνατομάς, ἐγνώ καὶ τὴν οἶον ἐντεριώνην τῶν νεύρων ἀπ' ἐγκεφάλου πεφυκῆναι. ἔχει δ' ἡ ρῆσις αὐτοῦ τόνδε τὸν τρόπον: "ἐθεωροῦμεν δὲ καὶ τὴν φύσιν τοῦ ἐγκεφάλου καὶ ἦν ὁ μὲν ἐγκέφαλος διμερῆς, καθάπερ καὶ τῶν λοιπῶν ζώων, καὶ κοιλία παραμήκεις τῷ εἶδει κείμεναι· συντέτηντο δ' αὐταὶ εἰς μίαν κατὰ τὴν συναφήν τῶν μερῶν· ἐκ δὲ ταύτης ἔφερον εἰς τὴν ἐπεγκρανίδα καλουμένην καὶ ἐκεῖ ἑτέρα ἦν μικρὰ κοιλία. διαπέφρακτο δὲ ταῖς μήνιγγιν ἕκαστον τῶν μερῶν· ἢ τε γὰρ ἐπεγκρανὶς διεπέφρακτο αὐτῇ καθ' ἑαυτὴν καὶ ὁ ἐγκέφαλος παραπλήσιος ὢν νήσκει καὶ πολὺπλοκος, πολὺ δ' ἐστὶ μᾶλλον τούτου ἢ ἐπεγκρανὶς πολλοῖς ἐλιγμοῖς καὶ ποικίλοις κατεσκευαστο. ὥστε μαθεῖν <ἐκ> τούτων τὸν θεωροῦντα ὅτι ὡσπερ ἐπὶ τῶν λοιπῶν ζώων, ἐλάφου τε καὶ λαγωοῦ καὶ εἴ τι ἄλλο κατὰ τὸ τρέχειν πολὺ τι τῶν λοιπῶν ζώων ὑπεραίρει τοῖς πρὸς ταῦτα χρησίμοις εὖ κατεσκευασμένον μυσί τε καὶ νεύροις, οὕτω καὶ ἀνθρώπῳ, ἐπειδὴ τῶν λοιπῶν ζώων πολὺ τῷ διανοεῖσθαι περίεστι, πολὺ τοῦτ' ἐστὶ <καὶ> πολὺπλοκον. ἦσαν δὲ καὶ ἀποφύσεις τῶν νεύρων αἱ πᾶσαι ἀπὸ τοῦ ἐγκεφάλου, καὶ καθ' ὅλον εἰπεῖν ἀρχὴ φαίνεται εἶναι τῶν κατὰ τὸ σῶμα ὁ ἐγκέφαλος. ἢ τε γὰρ ἀπὸ τῶν ῥινῶν γιγνομένη αἴσθησις συντέτηντο ἐπὶ τούτων καὶ αἱ ἀπὸ τῶν ὠτων. ἐφέροντο δὲ καὶ ἐπὶ τὴν γλῶσσαν καὶ ἐπὶ τοὺς ὀφθαλμοὺς ἀποφύσεις ἀπὸ τοῦ ἐγκεφάλου." ἐν τούτοις ὁ Ἐρασίστρατος ὁμολογεῖ τὸ πρότερον ἀγνοούμενον ἐαυτῷ σαφῶς ἑωρακέναι τῆσιν αὐτῷ, τῶν νεύρων ἕκαστον ἐξ ἐγκεφάλου φυόμενον. ἀκριβῶς δὲ καὶ περὶ τῶν τεττάρων αὐτοῦ κοιλιῶν ἔγραψεν, ὡς οὐδ' αὐτὰς ἔπει τῷ πρότερον εἶδεν.

³¹ On the fact that 'heart-wood' is Galen's term, and implies nothing about Erasistratus' views on the hollowness of the nerves, see Solmsen 1961: 188-90.

nerves as coming from the brain. I shall argue presently, however, that care is needed in interpreting these statements, and that there are further contextual details that must be taken into account, so I shall leave the content of the Erasistratean quotation aside for a brief moment, and concentrate on how Galen presents his claim. Firstly, despite what he says about it, Erasistratus offers no hint in the passage quoted that what he is stating constitutes a revision of an earlier position that he adopted. There is no reference to any alternative views at all. Moreover, Galen is elsewhere more forthcoming about just how controversial his interpretation of Erasistratus' position is. In his *Commentary on Aphorisms*, we learn that the Erasistrateans themselves failed to take account of the fact that their founder had changed his mind about the origin of the nerves. In fact, they continued to adhere to the view that other sources attribute to Erasistratus himself, namely that the meninges are the source of the nerves. As Galen tells us:³²

The Erasistrateans, since they posit the meninges as the origins of the nerves, will say that because of its own nature the thick meninx (i.e. dura mater) brings about these symptoms (i.e. fever and vomiting bile) when it alone has been pierced. But if the piercing should reach to the brain, they will say that the generation of the aforementioned affections follows in this way, namely by the piercing of both meninges first. I said that the Erasistrateans will say this, and not Erasistratus himself, since when he was an old man, at the time when they themselves say that he wrote the books *On Divisions*, he declared that the brain was the origin of the nerves. I have spoken in greater detail on this in the books *On Hippocrates' Anatomy*.

This passage also confirms, which might be expected in any case, that Erasistratus' followers had access to the relevant work, *On Divisions*, in which Erasistratus allegedly recanted his position, yet they evidently saw no reason to revise their own views in light of this. Moreover, it seems that Galen's knowledge of the relative chronology of Erasistratus' writings was due to the Erasistrateans, rather than to anything in Erasistratus' works directly available to Galen himself. So Galen accuses them of holding a view on the origin of the nerves that was different from their master's.

At this point in *PHP*, of course, it is to Galen's advantage to have Erasistratus on side. Galen is reviewing his proof, based on the anatomy of the brain and nervous system, that the rational soul is located within the brain. In second century AD Rome, Erasistratus' acknowledged authority in anatomy could be a problem if he had in fact denied that the brain was the origin of the nerves at all, but would obviously add weight to Galen's case if he had been in agreement. Perhaps most significantly, Galen is also engaged here in a personal dispute with a contemporary Erasistratean physician named Martialis, against whom the (lost) treatise *On Hippocrates' Anatomy*, explicitly mentioned in the passage above, was directed. As Galen states in his treatise *On my Own Books*, '<When (Martialis) learned that I praised Hippocrates, he announced that Hippocrates was> not at all <a subject of anatomical study for him,> and he declared the superiority of Erasistratus in all areas of the art, but especially in this. So it was because of him that I wrote the six books *On Hippocrates' Anatomy* and the

³² Fr. 288 Garofalo = Gal. *Hipp. Aph.* 6.50 [xviii/A 86 K.], οἱ δ' Ἐρασιστράτειοι τὰς μήνιγγας τῶν νεύρων ἀρχὰς τιθέμενοι, διὰ μὲν τὴν αὐτῆς φύσιν ἐροῦσι τὴν παχεῖαν μήνιγγα ταῦτα ἐπιφέρειν τὰ συμπτώματα μόνην τρωθεῖσαν. εἰ δὲ καὶ πρὸς τὸν ἐγκέφαλον ποτε ἢ τρωθῆναι ἐξίκοιτο, τῷ φθάνειν ἀμφοτέρως προτιτρώσκεσθαι τὰς μήνιγγας, οὕτω φήσουσι τὴν τῶν εἰρημένων γένεσιν ἀκολουθεῖν παθημάτων. Ἐρασιστρατείου δ' ἔφην ἐρεῖν ταῦτα καὶ οὐκ αὐτὸν Ἐρασίστρατον, ὅτι πρεσβύτερος ὢν ἤδη καθ' ὃν χρόνον αὐτοῖ φασι τὰ τῶν Διαπρέσεων αὐτῶ γεγράφθαι βιβλία, τὸν ἐγκέφαλον ἀπεφήνατο τῶν νεύρων ἀρχὴν ὑπάρχειν. λέλεκται δὲ περὶ τούτων ἐπὶ πλέον ἐν τοῖς Περὶ τῆς Ἱπποκράτους ἀνατομῆς ὑπομνήμασιν.

three *On Erasistratus' Anatomy* in this rather combative vein'.³³ So Galen's strategy will have been to accuse Martialis of being ignorant not only of the anatomical truth, but also of the fact that the founder of his own school had himself at the end of his life come to realise this truth. We are forced to wonder, then, why Martialis and other Erasistrateans did not adopt Erasistratus' mature view concerning the source of the nerves, which Galen claims he set out clearly in his late work *On Divisions*. Why is Galen the only figure who recognises that Erasistratus changed his mind? It seems difficult to answer this question without further evidence. On the one hand, the meninges clearly played a key role according to many sources, including Galen. When Erasistratus stated in the above quotation that 'the outgrowths of the nerves were all from the brain; and speaking generally (καθ' ὅλον εἰπεῖν) the brain appears to be the source (ἀρχή) of the nerves in the body', it is perhaps possible that he meant loosely the brain *as including* its meninges, rather than the brain *as opposed to* the meninges, as Galen took it.³⁴ On the other hand, the passage clearly appears to substantiate Galen's interpretation, and the Erasistrateans could have preferred to prioritise a theory which privileged the meninges over the brain, a theory which may have been more closely integrated with the rest of Erasistratus' doctrine of the *triplokia*.

The passage also correlates the superior ability in rational thought (διανοεῖσθαι) of humans with the greater size of the brain and its greater number of convolutions: just as fast-running animals are well provided with parts (sinews and muscles) that are useful for this activity, so apparently the size of the human brain and its convolutions can contribute to its superior ability to think. This might be taken to suggest that thinking actually takes place in the brain's convolutions, but only if one believed that thinking must take place in a physical organ. Aristotle, for example, correlates watery blood with a keener intellect (*dianoia*), and this is explained in part by their improved perception.³⁵ However, this was certainly not meant as evidence that thinking occurs in the blood. Similarly, Erasistratus' thought might have been that the greater number of convolutions makes the overlying meninges more convoluted and the pattern of arteries and nerves more complex, which could have consequences for the refinement of pneuma as it passes from the arterial terminations into the nerves, and hence for the transmission of perceptions.³⁶ In any case, Erasistratus shows no

³³ *Libr. Prop.* 1.9-10 [19.14 K. = p. 138 Boudon-Millot]. On Martialis, and his identification with the doctor named Martianus in the MSS of Galen's *On Prognosis*, see Boudon-Millot 2007: 185-6.

³⁴ It may be noted that Erasistratus observes that the meninges also extend *within* the body of the brain. Thus the cerebrum and cerebellum, and apparently each of the ventricles, 'had been partitioned off by the meninges'. This should refer at least to the *tentorium cerebelli*, the fold of the dura mater which separates the cerebellum from the cerebrum, but perhaps also the *falx cerebri*, the fold separating the two cerebral hemispheres. So Erasistratus recognised that the meninges did not only cover the exterior of the brain tissue, but also penetrate deep into its structure. Nor does Erasistratus show signs here of wishing to be precise about where the nerves originate at all. The brain, after all, is a large organ, and the passage has just carefully distinguished between different parts of its structure. There is also a good chance that Erasistratus had in the back of his mind Aristotle's claim, at *HA* 3.5, 515a 27-28, that the heart is the source of the body's *neura*, and was here rejecting it: the *neura* are to be traced, not to the heart, but to the brain, specifically to their membranes.

³⁵ *PA* 2.4, 650b 19-23, συμβαίνει δ' ἐνία γε καὶ γλαφυρωτέραν ἔχειν τὴν διάνοιαν τῶν τοιούτων, οὐ διὰ τὴν ψυχρότητα τοῦ αἵματος, ἀλλὰ διὰ τὴν λεπτότητα μᾶλλον καὶ διὰ τὸ καθαρὸν εἶναι· τὸ γὰρ γεῶδες οὐδέτερον ἔχει τούτων. εὐκίνητοτέραν γὰρ ἔχουσι τὴν αἴσθησιν τὰ λεπτοτέραν ἔχοντα τὴν ὑγρότητα καὶ καθαρωτέραν ('Some at any rate of the animals with watery blood have a keener intellect. This is due not to the coldness of their blood, but rather to its thinness and purity; neither of which qualities belongs to the earthy matter. For the thinner and purer its fluid is, the more easily affected is an animal's sensibility', trans. Ogle). Also *PA* 2.2, 648a 2-4, ἔστι δ' ἰσχύος μὲν ποιητικώτερον τὸ παχύτερον αἷμα καὶ θερμότερον, αἰσθητικώτερον δὲ καὶ νοερώτερον τὸ λεπτότερον καὶ ψυχρότερον ('The thicker and the hotter blood is, the more conducive is it to strength, while in proportion to its thinness and its coldness is its suitability of for sensation and intelligence', trans. Ogle).

³⁶ Most, if not all, processes in Erasistratus' account of the body's functioning appeal to the dynamics of certain kinds of fluids, blood, pneuma, and so on, travelling through distinct conduits. Although Erasistratus' term

intention to develop his suggestion in the quotation: he has observed a peculiar feature of the human brain, and, given his broader teleological commitments,³⁷ this demands an explanation of its purpose if possible. But he does not offer a physiology of thinking.

However Erasistratus worked out these details, there are general parallels here with Herophilus' approach: for Erasistratus too, the body's principal capacities were carried out by complex and integrated processes that converged upon, but were by no means restricted to, the heart and the area of the brain. Erasistratus reduced physiological function to three main systems, two originating in the heart, and one in the brain's membranes, or perhaps, in a modified version, in the brain itself. This coheres well with Galen's report that Erasistratus 'clearly stated in his *On Fevers* that there is not only a vital capacity in the heart, but also a psychic one'.³⁸ Common to Herophilus and Erasistratus too is the view that all of these different functions are performed by different fluid substances: blood within the venous system, and pneuma, which was derived from respiration, but found at different levels of elaboration throughout the arterial and nervous systems. There is no sense of a hierarchy of systems here, or of the privileging of particular organs; if anything, it is the vessels that are functionally most significant, but the emphasis generally seems to be on the balanced and integrated working of all systems simultaneously throughout the body.

Herophilus and Erasistratus on the soul?

A more fundamental question that arises is just how far Herophilus and Erasistratus were interested in questions concerning the nature of the soul and its interaction with the body at all. Some have argued that both Herophilus and Erasistratus had developed views on the soul's corporeality, and believed that its substance was pneuma.³⁹ The evidence, however, does not seem to bear this out. For Herophilus, the only potentially relevant testimonium was found in a Latin translation of an Arabic translation of Galen's work *On my Own Opinions*, but the original Greek text resurfaced in 2005, and shows that it was in fact Empedocles who was referred to, not Herophilus (nor is Empedocles attributed a view on the pneumatic nature of the soul).⁴⁰ Similarly, there is no evidence that Erasistratus actually identified the psychic pneuma which flows through the nerves with the soul itself, nor indeed that he made any claims at all about the substance of the soul *per se*. Galen is our main source for Erasistratus' theory of psychic pneuma, and he never suggests that Erasistratus actually identified it with the soul.⁴¹ Galen himself adopts the concept of psychic pneuma in his own system, which was directly influenced in various ways by Erasistratus', but he repeatedly clarifies that his use of the concept carries no implications about the soul's substance, of which he declares

eligmōi can refer to hollow convolutions (e.g. of labyrinths or intestines), in the case of the solid brain matter the image should be more in line with the plies of a knotted rope, for example.

³⁷ For Erasistratus' teleology, and its relation to Aristotle's, see von Staden 1997 and Cambiano 2000.

³⁸ Fr. 205 Garofalo = Gal. *Diff. Puls.* 4.17 [viii 760 K.].

³⁹ E.g. von Staden 2000: 87, '[Herophilus] shares [Epicurus' and the Stoics'] belief that the material substance of the *psychē* is, in some respects, different from that of the body; and, like the Stoics, he claims that the substance of the soul is pneuma'; and 95, '[according to Erasistratus,] the arterial system carries some of the vital pneuma to the brain ..., where it becomes still more highly refined, namely into soul-pneuma, which is the soul'.

⁴⁰ T145b von Staden = Gal. *Prop. Plac.* 7.4 [CMG V 3, 2 p. 80 Nutton]: see now the text edited in Boudon-Millot and Pietrobelli 2005, at p. 179.23, based on the recently discovered manuscript Vlatadon 14.

⁴¹ Galen's attribution to Erasistratus of the phrase πνεῦμα ψυχικόν is corroborated once in the treatise *De Morbis Acutis et Chronicis* by the so-called Anonymus Parisinus, though it is there also attributed, certainly anachronistically, to Hippocrates (fr. 174 Garofalo = *Morb. Ac. et Chron.* 4.1.2 [p. 26.7 Garofalo]).

himself ignorant.⁴² In fact, we have testimonia attributing to Erasistratus the view that pneuma is just a tool (σύνεργον) of the body's natural faculties.⁴³ There is no sign that either Herophilus or Erasistratus put forward, or even assumed, a fully-fledged theory of the soul. In their theories, as far as we can tell, pneuma was merely the physical substance by which certain bodily functions were mediated, not only sensation and voluntary motion, but also, for example, the digestion of food.

More general considerations concerning their conception of the medical art point in the same direction. Both doctors were concerned to define carefully the proper domain of medicine in relation to natural philosophy. For them, one of the things that belonged to natural philosophy, but not to medicine, was the inquiry into the elements: according to both Herophilus and Erasistratus, doctors need only study the human body from the level of the uniform parts up, and do not have to know about its constitution at the elemental level; that, rather, is for philosophers to be concerned with. There was an apparently well known dictum attributed to Herophilus which was intended to describe this distinction, quoted independently by both Galen and the Anonymus Londinensis papyrus: he is said to have made the stipulation: 'Let the apparent things be called primary, even if they are not primary.' Here both Galen and the Anonymus understand the apparent things as the uniform parts of the body, being the most fundamental *perceptible* parts; the elements, even though more primary by nature, do not fall within the purview of medicine.⁴⁴ The Anonymus openly aligns himself with Herophilus over this restriction, and prefaces it with another one, which rules out the study of the soul for doctors: 'the human being is composed of soul and body ... Regarding the soul, I defer to others, but we must be concerned with the body, since medicine is especially focused on this'.⁴⁵ This restriction on the soul is not attributed explicitly to Herophilus, or to Erasistratus, but the run of the passage suggests that it would have been fully consistent with their *more stringent* restrictions regarding the study of the elements. So it is doubtful whether a theory of the soul would have been of any interest to their narrowly defined medical aims.⁴⁶ I suggest that the inquiry into the soul and its functioning is likely to have been another topic which the Alexandrians doctors left to the philosophers. This is not to say that Herophilus and Erasistratus are likely to have been unfavourable in principle to the study of the soul; rather, from their point of view as doctors, it was irrelevant to the aims of the medical art.

Herophilus and Erasistratus, then, will have been interested only in basic bodily functions – functions such as nutrition and digestion, motion, and sensation, which are clearly

⁴² E.g. Gal. *PHP* 7.3.30 [5.609 K. = *CMG* V 4, 1, 2 p. 446 de Lacy], ... ἐδιδάχθημεν, ὅτι τε τὸ ψυχικὸν πνεῦμα μήτ' οὐσία ψυχῆς ἐστὶ μήτε οἶκος αὐτῆς, ἀλλ' ὄργανον πρῶτον ('we learned that the psychic pneuma is neither the substance of the soul, nor its home, but its first instrument'); *Ut. Resp.* 5.1 [4.501 K. = p. 120 Furley and Wilkie], εἴπωμεν δὲ πρότερον, πῶς καλοῦμεν τι ψυχικὸν πνεῦμα, ἀγνοεῖν ὁμολογοῦντες οὐσίαν ψυχῆς ('Let us state first the way in which we call a thing "psychic pneuma", since we concede that we are ignorant about the substance of the soul'); also *Prop. Plac.* 7 [*CMG* V 3, 2 p. 80 Nutton = p. 179 Boudon-Millot and Pietrobelli].

⁴³ Fr. 86 Garofalo = ps.-Gal. *Int.* 9.3 [14.697 K. = p. 21 Petit], δυσὶ γὰρ ὕλαις ταῦτα διοικεῖσθαι λέγει τὸ ζῶον, τῷ μὲν αἵματι ὡς τροφῇ, τῷ δὲ πνεύματι ὡς συνεργῶ εἰς τὰς φυσικὰς ἐνεργείας ('For he says that these (i.e. fluids and pneumas) regulate the animal with two materials: blood as nourishment, and pneuma as a *synergon* for the natural activities').

⁴⁴ For full discussion of Herophilus and Erasistratus' methodological pronouncements regarding the study of the elements, see Leith 2015b.

⁴⁵ Anon. Lond. xxi 13-18 [p. 45 Manetti], [σ]υνέστη[κεν δὲ] ὁ ἄνθρωπος | ἐκ [ψυ]χῆ[ς] καὶ σώμ[α]τ[ο]ς ... [καὶ πε]ρὶ μ[ε]ν ψυχῆς | [ἄλλοι]ς ἀν[α]βάλλομα[ι, ἡμῖν δὲ] τοῦ σώμ[α]τ[ο]ς μ[ε]λητέον ἐπεὶ [μάλιστα] περὶ τοῦτο [σπου]δάξει ἡ ἰατρικ[ή].

⁴⁶ This is not to suggest that ancient doctors in general were uninterested in the soul *per se*: later physicians, such as Asclepiades of Bithynia and Galen, were of course directly interested in such matters. But these doctors also believed, significantly, that the inquiry into the elements was a necessary part of medicine.

associated with (often newly identified) bodily structures,⁴⁷ and are mediated by the bodily fluids, especially blood and pneuma. It is precisely these functions which, firstly, need to be understood in order to preserve human health and prevent disease, and which, secondly, are within the doctor's power to influence using medical treatments. From this perspective, both the brain and the heart play different but similarly fundamental roles. But there is no sign that this physiological analysis was meant to be applied to any more fundamental psychology: there is no inquiry into the soul's materiality implied here, or its structure, or the question of how it interacts with the body.

Within this general context, it seems to me to make little sense to describe Herophilus and Erasistratus' theories in terms of locating a *hēgemonikon* in a single part of the body. They show no sign of having assumed a unified, corporeal soul. Nor is there the idea of a central ruling part in control of all other basic functions, nor of a single substance mediating these functions simultaneously. Their analysis is simply not comparable to the Stoic theory.

Yet the discovery of the nervous system was evidently of interest to the Stoics in this connection, Chrysippus in particular. In the next section, I shall look at the evidence for Chrysippus' engagement with Herophilus and Erasistratus, and speculate on how his discussion might have influenced subsequent accounts of their views.

Chrysippus on the nervous system

Our knowledge of Chrysippus' response comes from Galen's treatise *On the Opinions of Hippocrates and Plato*, which contains extensive verbatim quotations from the Stoic's treatise *On the Soul*. Chrysippus began his inquiry into the location of the *hēgemonikon* in the second part of *On the Soul* book 1, as Galen specifies. Here he observed that various predecessors had proposed locations for the *hēgemonikon*, and among them were both doctors and philosophers. Some of these had proposed different locations within the head, and it is highly likely that Herophilus and Erasistratus will have been among the doctors Chrysippus had in mind. Galen gives the following verbatim quotation from Chrysippus' *On the Soul* book 1:⁴⁸

But about the governing part of the soul there is disagreement, some placing it in one region, others in another. For some say it is located in the chest, others in the head. And there are differences even within these locations, as they do not agree among themselves where in the head or chest it is located. Plato, who said that the soul has three parts, placed the rational part in the head, the spirited in the region of the chest, and the desiderative in the region of the navel. Thus the place seems to elude us, since we have neither a clear perception (of it), as we had with the others, nor sure signs from which this matter might be inferred; otherwise disagreement among physicians and philosophers would not have grown so great.

⁴⁷ Note that the arteries were first distinguished from the veins by Herophilus' teacher Praxagoras.

⁴⁸ *PHP* 3.1.12-15 [p. 170 de Lacy], trans. de Lacy, *περι δὲ τοῦ ἡγεμονικοῦ μέρους τῆς ψυχῆς διαφωνοῦσιν ἄλλοι ἐν ἄλλοις λέγοντες αὐτὸ εἶναι τόποις. οἱ μὲν γὰρ περὶ τὸν θώρακά φασιν εἶναι αὐτό, οἱ δὲ περὶ τὴν κεφαλὴν. κατὰ τὰ αὐτὰ δὲ ταῦτα διαφωνοῦσι, ποῦ τῆς κεφαλῆς καὶ τοῦ θώρακός ἐστιν, οὐ συμφωνοῦντες αὐτοῖς. Πλάτων δὲ καὶ τριμερῆ τὴν ψυχὴν φήσας εἶναι τὸ μὲν λογιστικὸν ἔλεγεν ἐν τῇ κεφαλῇ εἶναι, τὸ δὲ θυμοειδὲς περὶ τὸν θώρακα, τὸ δὲ ἐπιθυμητικὸν περὶ τὸν ὀμφαλόν. οὕτω φαίνεται διαφεύγειν ὁ τόπος ἡμᾶς οὔτ' αἰσθήσεως ἔκφανοῦς γενομένης, ὅπερ ἐπὶ τῶν λοιπῶν συντετύχηκεν, οὔτε τῶν τεκμηρίων δι' ὧν ἂν τις συλλογίσαιτο τοῦτο· οὐδὲ γὰρ ἂν ἀντιλογία ἐπὶ τοσοῦτον προῆλθεν καὶ ἐν ἰατροῖς καὶ ἐν φιλοσόφοις.*

In the course of Chrysippus' subsequent discussion, the nervous system and its origin then came up, as Galen tells us on several occasions,⁴⁹ specifically in the context of the Stoic speech argument. Galen reports Chrysippus' version of the speech argument as follows: 'It is reasonable that that to which the meanings in this go and out from which discourse (λόγος) comes is the sovereign part of the soul. For it is not true that the source of discourse (λόγος) is other than the source of thought (διάνοια), or, to state the whole matter simply, that the source of speech is other than the sovereign part of the soul'.⁵⁰ Chrysippus evidently saw the function of the nervous system as a potential threat to his cardiocentrism, which needed to be countered: the fact that the nerves issue from the brain and mediate voluntary motion might be taken to conflict with his view that speech, and conation in general, arise in the *hēgemonikon* in the heart. Galen offers a single excerpt⁵¹ from Chrysippus' broader response to this potential problem.⁵²

"But as I said, it is more important for them on all counts if perhaps this too should be granted, that according as they travel about, the source is from the head to the parts mentioned. Let us examine (the matter) further. Surely the same sort of statement that they might make about speech, that it is carried out of the chest through the windpipe with an initiation of some kind coming from the head, can be made if the governing part is in the heart but the beginning of the movements is from the head." What Chrysippus means in this passage is this: even if a person should concede that the head is the source of nerves, he will not necessarily concede that the governing part is also in the head. For the kind of statements that those others can make about speech being carried out of the chest through the windpipe while the head sends the beginning of action to the parts, may be made to us about the nerves, that they start from the head but receive their activity from the heart.

At this point in his argument, Chrysippus appears to have accepted, at least provisionally, the premise that the source of voluntary motion may be in the head.⁵³ But he argues that, even if

⁴⁹ See *PHP* 3.5.35 [p. 208 de Lacy], ἐξῆς δὲ περί τε φωνῆς μνημονεύει καὶ νεύρων ἀρχῆς, ὑπὲρ ὧν ἀμφοτέρων εἴρηται μοι κατὰ τὰ πρόσθεν ὑπομνήματα ('Next he takes up speech and the source of the nerves, both of which I discussed in the preceding books'); *PHP* 3.7.55 [p. 222 de Lacy], μετὰ δὲ τὸ πλῆθος τῶν ἐπῶν ἐφεξῆς ὁ Χρυσίππος περὶ τε φωνῆς καὶ λόγου καὶ νεύρων ἀρχῆς ὅσα τε τούτοις συνέζευκται διήλθεν, ἃ δὲ καὶ μόνα τῶν κατὰ τὸ βιβλίον ἔπρεπεν ἀνδρὶ φιλοσόφῳ ('After the spate of hexameters, Chrysippus next took up the source of speech, discourse and nerves, and matters related thereto. These are the only things in his book that befit a philosopher').

⁵⁰ *PHP* 2.5.15-16 [p. 130 de Lacy]. Galen also records Zeno's and Diogenes of Babylon's versions of the argument at *PHP* 2.5.7-13 [pp. 128-30 de Lacy].

⁵¹ Note e.g. in the following quotation that there is no plausible antecedent in the surviving fragments for Chrysippus' reference to a previous discussion ('As I said, ...'). Similarly, who 'they' are in the passage quoted is never explicitly stated, though of course Galen implies that it is Herophilus and Erasistratus; perhaps these figures were indeed named by Chrysippus in the earlier discussion to which he has just referred. Again, the passage in which he cites Praxagoras' views on *neura* (see below) is not quoted by Galen.

⁵² *PHP* 2.5.69-70 [p. 140 De Lacy], "ἔχει δ' ὡς ἔφην πλείονα αὐτοῖς ἐπὶ πᾶσι, μή ποτ' εἰ καὶ τοῦτο δοθείη, καθάπερ ἐπιπορεύονται, ἀπὸ τῆς κεφαλῆς εἶναι τὴν ἀρχὴν ἐπὶ τὰ εἰρημένα μέρη. ἐπιζητήσωμεν· σχεδὸν γάρ, οἷα ἂν τινα λέγοιεν περὶ τοῦ τὴν φωνὴν ἐκ τοῦ στήθους φέρεσθαι διὰ τῆς φάρυγγος, ἀπὸ τῆς κεφαλῆς ποιᾶς τινος καταρχῆς γιγνομένης, τοιαῦτ' ἔξεστι λέγειν, ἐν τῇ καρδίᾳ μὲν τοῦ ἡγεμονικοῦ ὄντος, τῆς δὲ τῶν κινήσεων ἀρχῆς ἀπὸ τῆς κεφαλῆς οὖσης." ὁ γὰρ δὲ βούλεται λέγειν ὁ Χρυσίππος ἐν τῇδε τῇ ῥήσει, τοιοῦτόν ἐστιν· εἰ καὶ συγχωρήσειε τις ἀρχὴν εἶναι νεύρων τὴν κεφαλὴν, οὐ πάντως ἐν αὐτῇ συγχωρήσει καὶ τὸ ἡγεμονικὸν ὑπάρχειν. ἃ γὰρ ἐκεῖνοι δύνανται λέγειν ὑπὲρ τοῦ τὴν φωνὴν ἐκ τοῦ στήθους διὰ τῆς φάρυγγος ἐκφέρεσθαι τὴν ἀρχὴν τῆς ἐνεργείας τοῖς μορίοις ἐπιπεμπούσης τῆς κεφαλῆς, τοιαῦτ' ἔξεστι λέγειν ὑπὲρ τῶν νεύρων ἡμῶν, ὡς ἐκ μὲν τῆς κεφαλῆς ἀρχομένων, ἀπὸ δὲ τῆς καρδίας τὴν ἐνέργειαν ἐχόντων.

⁵³ For discussion, see Tieleman 1996: 51-2. Chrysippus does not mention voluntary motion or the nerves specifically in the quotation, but Galen notes elsewhere that he discussed 'speech and the source of nerves' in

it were, this need not threaten his cardiocentrism. Speech, he takes it, unquestionably arises from the chest. So on the account of those who believe that motions are initiated in the head, there must be some subordinate centre in the chest from which the motions involved in speech arise. But once this notion of a subordinate centre is introduced, there seems no reason why it should not also complicate his opponents' model. Identifying the source of the nerves, he argued, cannot straightforwardly tell us where the *hēgemonikon* is. So in this context Chrysippus was not calling the anatomists' findings into question; rather he wanted to show that the functioning of the motor nerves issuing from the brain would be compatible with his cardiocentrism.

Elsewhere, however, Galen tells us that Chrysippus adduced the account of Herophilus' teacher Praxagoras of Cos⁵⁴ against the Herophilean/Erasistratean view:⁵⁵

But since I have this once become engaged in examining all views, I wish to argue briefly with Praxagoras, especially because Chrysippus too mentioned the man, opposing him to those who hold that the nerves take their beginning from the head.

It is plausible, as Teun Tieleman has argued, that Chrysippus' engagement with such scientific views was dialectical in nature: he need not have accepted Praxagoras' views as true, but merely wished to emphasise the disagreement among experts (though Tieleman is also happy to accept that Chrysippus actively took on various aspects of Praxagoras' physiology in other contexts).⁵⁶ Chrysippus himself, it may be noted, disavowed any detailed knowledge of human anatomy:⁵⁷

You might nevertheless put up with Chrysippus, who modestly declared that his heart did not vouchsafe to him either the knowledge that it is the source of the nerves, or any other answer to the questions that arise in connection with this problem; for he admits that he is ignorant of anatomy.

He thus conceded the authority of the doctors on technical issues, and so he needed such an authority, in this case Praxagoras, to counterbalance Herophilus' discovery of the nervous

the same context (see n. 49 above), and it seems very likely that this argument was directed at those who located the origin of the nervous system in the head, as Galen claims.

⁵⁴ For Praxagoras, Steckerl 1958 should be used with some caution; see now Lewis 2017 for Praxagoras' physiology.

⁵⁵ *PHP* 1.7.1 [p. 82 de Lacy], ἐγὼ δὲ ἐπειδὴ περ ἄπαξ κατέστην εἰς τὸ περὶ πάντων διασκέψασθαι, βραχέα τῷ Πραξαγόρᾳ διαλεχθῆναι βούλομαι καὶ μάλισθ' ὅτι καὶ Χρῦσιππος ἐμνημόνευε τάνδρος ἀντιθεῖς τοῖς ἀπὸ τῆς κεφαλῆς ἄρχεσθαι τὰ νεῦρα νομίζουσιν.

⁵⁶ For Chrysippus' engagement with scientific material, see Tieleman 1996: 189-95; for his use of Praxagoras, Tieleman 1996: 83-5.

⁵⁷ *PHP* 1.6.13-14 [p. 80 de Lacy], καίτοι Χρῦσιππον μὲν ἂν τις ἀποδέξαιτο μετρίως ἀποφηνάμενον ὡς μήθ' ὅτι τῶν νεύρων ἀρχὴ ἢ καρδία τὴν γινῶσιν αὐτῶ χαρίζεται μήτ' ἄλλο μηδὲν τῶν κατὰ τὸ πρόβλημα τοῦτο ζητουμένων· ὁμολογεῖ γὰρ ἀπείρως ἔχειν τῶν ἀνατομῶν.

system.⁵⁸ Galen describes Praxagoras' anatomy of *neura*, which presumably constituted at least part of what Chrysippus opposed to those who hold that the nerves begin in the head:⁵⁹

[Praxagoras] ventured on no inconsiderable fiction: he said that as the arteries advance and divide they become constricted and change into *neura*; for since their body is *neuron*-like but hollow, and the hollows get so small with the progressive divisions in the animal that the tunics (of the artery) come together, as soon as this happens, the vessel then appears as a *neuron*.

Galen portrays this as a fantastical account of the origins of the nerves, that is, of the nervous system as we would recognise it. But this is clearly not what Praxagoras had in mind: his remarks concerning the arteries becoming *neura* need amount only to the Aristotelian observation that at their extremities blood vessels become like *neura* in that their cavity disappears.⁶⁰ This is what Aristotle has to say in *History of Animals*:⁶¹

The *neura* of animals are arranged as follows. The starting-point of them, as of blood-vessels, is the heart: the heart has *neura* within itself, in the largest cavity; and the aorta as it is called is a *neuron*-like blood vessel; indeed, its extremities are wholly *neuron*-like, for they are not hollow, and it can be stretched in the same way as the *neura* where they terminate at the joints of the bones. Nevertheless, the *neura* do not constitute a continuous system from one starting-point, as the blood vessels do.

Both Praxagoras and Aristotle seem to think of the arteries and the *neura* as similarly elastic structures; what distinguishes them is the fact that arteries are hollow, while *neura* are solid.⁶² But the arteries get narrower as they ramify, until their coats finally come into contact and become solid and uniform, at which point this distinction disappears and they become basically *neura* themselves.

Praxagoras, then, was not talking about nerves, but about *neura*, that is, about generic cord-like structures in the body that might include tendons and ligaments. Hence his observation about the connection between *neura* and arteries does not in fact conflict with Herophilus and Erasistratus' location of the origin of the nerves in the brain, though

⁵⁸ Cf. Plut. *Stoic. Rep.* 1047C, 'In the *Physical Propositions*, (Chrysippus) has exhorted us to be quiet about matters requiring scientific experience and research if we have not something of greater force and clarity to say, "in order," he says, "not to make surmises either like Plato's that the liquid nourishment goes to the lungs and the dry to the belly or other errors like this"'. Plato was criticised on the former point by Aristotle (*PA* 3.3, 664b 2-35) and Erasistratus (Plut. *Quaest. Conv.* 697F ff.), who both pointed to the function of the epiglottis. Praxagoras similarly described the epiglottis, though we do not know whether he linked this to an explicit criticism of Plato (fr. 10 Steckerl). See further Tieleman 1996: 191-4.

⁵⁹ *PHP* 1.6.18 [p. 82 de Lacy], οὐ σμικρὸν ἀπετόλμησε νεύσασθαι τὰς ἀρτηρίας φάμενος ἐν τῷ προϊέναι καὶ κατασχιζέσθαι στενὰς γιγνομένας εἰς νεῦρα μεταβάλλειν· τοῦ γὰρ δὴ σώματος αὐτῶν ὑπάρχοντος νευρώδους μὲν ἀλλὰ κοίλου, <καὶ> κατὰ τὴν ἐπὶ πλεον ἐν τῷ ζῳῷ σχίσιν οὕτως γιγνομένων μικρῶν τῶν κοιλοτήτων ὡς ἐπιπίπτειν ἀλλήλοις τοὺς χιτῶνας, ὁπόταν τοῦτο πρῶτον γένηται, νεῦρον ἤδη φαίνεσθαι τὸ ἀγγεῖον.

⁶⁰ For full discussion of this point, see Lewis 2017: 235-6, 280-3.

⁶¹ *HA* 3.5, 515a 29-32 (after Peck), τὰ δὲ νεῦρα τοῖς ζῳοῖς ἔχει τόνδε τὸν τρόπον· ἡ μὲν ἀρχὴ καὶ τούτων ἐστὶν ἀπὸ τῆς καρδίας· καὶ γὰρ ἐν αὐτῇ ἡ καρδία ἔχει νεῦρα ἐν τῇ μεγίστῃ κοιλίᾳ, καὶ ἡ καλουμένη ἀορτὴ νευρώδης ἐστὶ φλέψ, τὰ μὲντοι τελευταῖα καὶ παντελῶς αὐτῆς· ἀκοῖλα γὰρ ἐστὶ, καὶ τὰσιν ἔχει τοιαύτην οἶαν περ τὰ νεῦρα, ἢ τελευτᾶ πρὸς τὰς καμπὰς τῶν ὀστέων· οὐ μὴν ἀλλ' οὐκ ἐστὶ συνεχῆς ἢ τῶν νεύρων φύσις ἀπὸ μιᾶς ἀρχῆς, ὡσπερ αἱ φλέβες.

⁶² Cf. also *HA* 3.3, 513b 7-11, καὶ ἔστιν ἡ μὲν μεγάλη φλέψ ὑμενώδης καὶ δερματώδης, ἡ δ' ἀορτὴ στενωτέρα μὲν ταύτης, σφόδρα δὲ νευρώδης καὶ ἀποτεινομένη πόρρω πρὸς τὴν κεφαλὴν καὶ πρὸς τὰ κάτω μέρη στενή τε γίνεται καὶ νευρώδης πάμπαν ('The Great Blood-vessel is membranous and skinlike in appearance, whereas the Aorta is narrower, and very *neuron*-like; and as it continues on farther towards the head and the lower parts of the body it becomes narrow and entirely *neuron*-like', after Peck).

Chrysippus evidently wanted his audience to believe it did. Neither Praxagoras nor Aristotle had a conception of the nervous system *per se* – that was born only with Herophilus’ identification of the nerves as a distinct structure issuing from the brain and spinal cord, and with his recognition of their function in mediating sensation and voluntary motion. Insofar as Praxagoras’ anatomy linked the *neura* with the heart, it did so only by emphasising the importance of the arterial system. There is no question here of the *neura* themselves originating in the heart. But Chrysippus, writing in the latter part of the third century BC, knew Herophilean/Erastratean descriptions of the *neura* as a unified and continuous network issuing from a single organ. This was quite different from the disunited and non-continuous conception of *neura* that Aristotle and Praxagoras held. So Chrysippus knew two distinct types of description of *neura*. An obvious difference between these was that the Herophilean/Erastratean version located the origin of the *neura* in the area of the brain, while the Praxagorean/Aristotelian version seemed to link them (albeit indirectly) with the heart. Therefore, a selective conflation of the two could yield, at least *prima facie*, a medically respectable description of the nervous system originating in the heart.

Evidence that just this conflation later became an established part of Stoic doctrine may be found in Cicero’s *On the Nature of the Gods*, where the Stoic spokesman Balbus offers human physiology as an argument for divine providence. In the course of his description, he refers to the structure of the *neura*: ‘Add to this the *nervi*, by which the limbs are held together, and their network which stretches out through the entire body; just like the veins and arteries which proceed continuously from the heart as their starting-point, they pass to all parts of the body’.⁶³ This Stoic physiology,⁶⁴ I believe, can best be made sense of as appealing to a fundamentally Herophilean conception of the nervous system, but one which has been anachronistically superimposed on a Praxagorean view regarding the arteries and *neura*. Here we have the idea that *neura* form a unitary network ramifying throughout the body, one which represents, together with the arteries and veins, the third major such network in human physiology. This is undoubtedly post-Herophilean. As we have seen, Praxagoras’ *neura* were not ‘nerves’, but rather the solid, ‘cord-like’ extremities of the arterial system, and they did not form a unified network spanning the entire body. On the other hand, although Balbus does not directly compare the nerves to the veins and arteries with regard to the latter’s origin in the heart,⁶⁵ one could nevertheless receive that impression from the report,⁶⁶ and there is certainly no mention of the brain or head. This physiology appears to run together a basically Herophilean/Erastratean conception of a unified nervous system with a more Praxagorean association of the *nervi* with the arteries and veins arising from the heart. Such a conflation is very similar to the one made by Galen in his refutation of Praxagoras’ account in book 1 of *PHP*.

All this makes perfect sense for Chrysippus, who was fully aware of the Alexandrian anatomy of the nervous system, found it a potential threat to his unified, cardiocentric psychology, but who was also aware of Praxagoras’ anatomy. While self-confessedly avoiding any direct investigation into the anatomical reality, he exploited (perhaps not fully consciously) the ambiguity in the terminology for *neura* in the medical tradition, and opposed

⁶³ Cic. *ND* 2.139 (trans. Rackham), *huc adde nervos, a quibus artus continentur, eorumque implicationem corpore toto pertinentem, qui sicut venae et arteriae a corde tractae et profectae in corpus omne ducuntur.*

⁶⁴ For association with Chrysippus in particular, see Hahm 1977: 162-3 and 181 n. 68; Tieleman 1996: 86 n. 82.

⁶⁵ I am grateful to John Wynne for impressing this point on me at the Symposium.

⁶⁶ As many have done: cf. e.g. Walsh’s translation, ‘Like the veins and arteries, they issue from the heart, and they spread to every part of the body’; Hahm 1977: 181 n. 68, ‘In Cic. *Nat. D.* 2.139 the *nervi* seem to be ligaments, at least primarily, and in addition originate in the heart’.

Praxagoras' account to that of Herophilus and Erasistratus, although the two accounts did not in fact conflict (at least not in the way he required).⁶⁷

For present purposes, one of the main points to emphasise is that the problem of the nervous system became acute for Chrysippus only because of the broader Stoic commitment to a unified, corporeal soul converging on a single, governing command centre. It is important to observe that Chrysippus devoted the first part of his *On the Soul* to establishing the substance of the soul *before* he came to discuss its structure.⁶⁸ (Note that this progression mirrors the sequence of topics in *Placita* 4.3-5.) At this point in his argument, it was already confirmed that the soul is a unified material substance, with parts that are internally connected, and that collectively converge on a central location that regulates and governs the whole. So given this theoretical background, the view that the nerves are responsible for mediating sensation and voluntary motion, and originate in the head, obviously points to the head as housing this central location (though not conclusively, as Chrysippus correctly pointed out). But if one does not conceive of the soul as a unified material substance with a single, central governing location, then the anatomy and physiology of the nervous system is hardly likely to point to the same sort of conclusion. For Herophilus and Erasistratus, the nervous system showed that the brain, or its meninges, played an important role in mediating sensation and voluntary motion, but that was basically all. The evidence suggests that Herophilus and Erasistratus were only interested in explaining fundamental physiological processes, and that these had their sources in both the brain and the heart. They had no motivation to posit a *single* organ or structure in the body that governed *all* fundamental functions. Nor, as doctors, were they interested in explaining such basic mental phenomena as thinking, emotion, etc., which may have had for them no clear physical basis, nor any clear relevance to the goals of medicine.⁶⁹ Herophilus and Erasistratus seem to have been interested rather in the fundamental processes connected with digestion, perception and voluntary motion, all of which were mediated by the physical substances of blood and pneuma derived from respiration. But it was not just the brain and/or its meninges that played a crucial role in mediating these basic processes: the heart was fundamental not only to digestion and nutrition, but also, for example, to natural motion, and it supplied the brain and its meninges with the pneuma which made its way into the nervous system. Herophilus and Erasistratus simply did not analyse bodily functions in terms of a corporeal soul with a central command centre.

Chrysippus, then, was forced to deal with the nervous system, not because physicians presented the nervous system as evidence for an encephalocentric conception of the soul's functioning, but because it seemed *to Chrysippus* to undermine his own, peculiar brand of cardiocentrism, and in particular the Stoic speech argument. If there could be only a single organ regulating all functions associated with the soul, then he needed an account of the nervous system that could be integrated with his broader psychology (especially the Stoic argument that rational speech comes from the chest), and at the same time had some anatomical respectability. Because Chrysippus' immediate concern was to establish the location of the *hēgemonikon*, he naturally addressed the issue of the nervous system only

⁶⁷ This would also be fully consistent with Chrysippus' claim that 'all the organs of sense extend to this part (sc. the *hēgemonikon* in the heart)' (quoted at *PHP* 3.5.31 [p. 206 de Lacy]): he could make this claim based on his revised anatomy of the nervous system, according to which the nerves issue from the heart.

⁶⁸ Gal. *PHP* 3.1.9-17 [p. 170 de Lacy].

⁶⁹ Again, this is not to suggest that ancient doctors in general could never have any interests in such mental phenomena - Galen is a clear counter-example -, but, as we have seen, Herophilus and Erasistratus appear to have been more restrictive than most physicians about the proper domain of medicine, as evidenced in their views on the inquiry into elements, and they were certainly criticised by Galen on this account.

insofar as it impinged on that particular question. Since it became a threat given Chrysippus' own theory, it makes sense that he should have considered the nervous system *within that theory's framework*. He was not interested in what Herophilus and Erasistratus thought about the functioning of the nervous system, but only in the (unforeseen) implications it had for his own analysis of the soul.

The Source of the *Placita* reports

The question remains why we have the *Placita* testimonia attributing to Herophilus and Erasistratus views regarding the location of the *hēgemonikon*, as if they did adhere to a Chrysippean psychology. I suggest that a plausible source for these testimonia is Chrysippus' own treatise. As we know from Galen's quotation, Chrysippus gave a doxographical overview of various views of doctors and philosophers as if they too were concerned with identifying the location of the *hēgemonikon*. Some of these, he tells us, located it in different parts of the head. To quote again from the passage above: 'For some say it is located in the chest, others in the head. And there are differences even within these locations, as they do not agree among themselves where in the head or chest it is located.'⁷⁰ Given Chrysippus' anxieties about the nervous system, he will certainly have had in mind here (perhaps among other views) Herophilus' tracing of the nerves to the base of the brain, and Erasistratus' tracing of them to the brain's meninges. And it is clear from his wording here and his argumentation discussed earlier that he would have taken 'location of the origin of the nerves' as a proxy for 'location of the *hēgemonikon*'. In defending his theory against the broader implications of their views, Chrysippus may well have given the impression that Herophilus and Erasistratus themselves were actually promoting a view which located the *hēgemonikon* in the brain or its meninges. The sort of material upon which the *Placita* entries on Herophilus and Erasistratus regarding the location of the *hēgemonikon* were based could have been available in Chrysippus' *On the Soul*.

Of course, these correspondences could alternatively be accounted for by positing a common source for the Aëtian *Placita* and Chrysippus' treatise. Jaap Mansfeld has argued that Chrysippus must have had access to a *Vetustissima Placita*, which was current in the third century, and already contained various views, including Herophilus and Erasistratus', on the location of the *hēgemonikon*.⁷¹ That certainly cannot be ruled out. But there are perhaps some reasons for looking to Chrysippus' *On the Soul* itself. An earlier source should likewise have attempted to give a peculiarly Stoic interpretation of Herophilus and Erasistratus' views in the way described above. But to my knowledge there is no sign that Cleanthes or any early Stoic engaged with the medical tradition in any such way before Chrysippus. Mansfeld objected that Chrysippus' short outline of the disagreements regarding the location of the *hēgemonikon*, which mentions Plato but no other authority by name, could not have been the source.⁷² But Chrysippus had dealt with those who located the origin of the nerves in the head in another part of his text in more detail.⁷³ We have every reason to believe that Chrysippus'

⁷⁰ *PHP* 3.1.12-13 [p. 170 de Lacy].

⁷¹ Mansfeld 1989: 334-8, and 1990: 3167-77.

⁷² Mansfeld 1989: 337 n. 97, 'I am not prepared to consider the possibility that Chrysippus' remark about the disagreement inspired the author(s) of the *Plac.* to compose the chapter on the *hegemonikon*; it is far too succinct to attract this kind of attention'.

⁷³ We know that he discussed the view that the nerves originate in the head, and that he referred to the upholders of this view in a passage which does not now survive (see above n. 51). He might even have staged a dialectical opposition between Herophilus and Erasistratus on this point, i.e. regarding their privileging of the

introductory outline of the disagreement was *not* the only place in which he discussed individual views. My suggestion is only that Chrysippus' exposition inspired the inclusion of the topic of the location of the *hēgemonikon*, and at least some of the entries: the *Placita* chapter had obviously been altered and updated in various ways by Aëtius' time, and Chrysippus' influence on its preserved content may have been relatively limited. I also doubt that it follows from the way in which Chrysippus introduces the disagreement that he must have expected his audience to be familiar with a specific text which listed the separate views with the name labels.⁷⁴ As Mansfeld also observed, on the other hand, the entries at *Placita* 4.2-5 proceed from the definition of the soul to the issue of its corporeality, then the number of its parts, and finally to the location of the *hēgemonikon*, in precisely the same sequence as in Chrysippus' *On the Soul*. Of course, this could just as well represent Chrysippus' direct influence on the *Placita* tradition as the other way around.

Strato of Lampsacus

If this is accepted, it might also help to account for what I regard as another peculiarity, namely the view that the *Placita* attributes to Strato of Lampsacus on the location of the *hēgemonikon*, immediately before the entries on Erasistratus and Herophilus (see introduction). We are told that Strato placed it in the 'mid-brow' (μεσόφρουν), the space between the eyebrows.⁷⁵ It is hard to see, however, what on earth could have made Strato wish to focus on this particular spot: there is nothing as far as I can tell in the medical or philosophical traditions which would recommend it as having any particular psychic importance.⁷⁶ There is another testimonium for Strato which mentions both the space between the eyebrows and the *hēgemonikon* close together, but there is no sign that this space holds any unique significance.⁷⁷

cerebellum or the meninges, as a way of undermining their authority, at the same time as he opposed Praxagoras' view to theirs.

⁷⁴ As Mansfeld 1989: 334, suggests.

⁷⁵ Sylvia Berryman discusses Strato's psychology in detail elsewhere in this volume, though she has different views on his relation to the medical tradition from mine. On the *hēgemonikon*, the relevant Stratonic testimonia are fr. 57-8 Sharples = fr. 119-121 Wehrli (ps.-Plut. *Plac.* 4.5; Tert. *DA* 15.4-5). See also fr. 66 Sharples = fr. 128 Wehrli (ps.-Plut. *Plac.* 5.24), which likewise mentions the space between the eyebrows as the location of the *hēgemonikon*, but the emendation of Plato's name to that of Strato is a modern conjecture, and the account of sleep it gives differs from that explicitly attributed to Strato in fr. 67 = fr. 129 Wehrli (Tert. *DA* 43.1-2).

⁷⁶ The view is normally taken to represent a basically encephalocentric theory, placing Strato at least loosely in the same camp as other thinkers such as Plato and the Hellenistic doctors. Yet the plain fact is seldom acknowledged that the space between the eyebrows, the μεσόφρουν, is not a part of the brain; Mansfeld 1989: 318-19 is surely quite correct to distinguish Strato's *doxa* from the encephalocentric views on the *hēgemonikon*. Modrak 2011: 391-2, suggests that '[p]erhaps, he was influenced by such considerations as the simultaneous visual perception through each eye, or the apparently simultaneous perception of sound through both ears, or odor through both nostrils', such that 'Strato would be inclined to situate the *hēgemonikon* equidistant from each eye or ear or nostril'. But such speculation serves only to highlight the inappropriateness of the space between the eyebrows for any theory of perception: that spot is certainly equidistant from the eyebrows, but not from the sense-organs.

⁷⁷ Fr. 63B Sharples = fr. 111 Wehrli (Plut. (?) *Lib.* 4), ὡς δὲ τὴν φωνὴν τοῖς ὠσίν αὐτοῖς ἐνηχοῦσαν ἔξω δοκοῦμεν εἶναι, τὸ ἀπὸ τῆς ἀρχῆς ἐπὶ τὸ ἡγεμονικὸν διάστημα τῇ αἰσθήσει προσλογιζόμενοι, παραπλησίως τὸν ἐκ τοῦ τραύματος πόνον οὐχ ὅπου τὴν αἴσθησιν εἴληφεν, ἀλλ' ὅθεν ἔσχε τὴν ἀρχὴν εἶναι δοκοῦμεν, ἐλκομένης ἐπ' ἐκεῖνο τῆς ψυχῆς ἀφ' οὗ πέπονθε. διὸ καὶ προσκόψαντες αὐτίκα τὰς ὀφρῦς συνάγομεν, τῷ πληγέντι μορίῳ τοῦ ἡγεμονικοῦ τὴν αἴσθησιν ὀξέως ἀποδιδόντος, καὶ παρεγκάπτομεν ἔσθ' ὅτε τὸ πνεῦμα, κὰν τὰ μέρη δεσμοῖς διαλαμβάνηται, <...> χερσὶ σφόδρα πιέζομεν, <ἐν>ιστάμενοι πρὸς τὴν διάδοσιν τοῦ πάθους καὶ τὴν πληγὴν ἐν τοῖς ἀναισθητοῖς θλίβοντες, ἵνα μὴ <τῷ> συνάμει πρὸς τὸ φρονεῖν ἀλγηδῶν γένηται.

Just as we think that the voice which sounds in our ears is outside, adding to the sensation the distance from the source to the *hēgemonikon*, in a similar way we think that the pain from the wound is not where the sensation has been received, but where it had its origin, the soul being drawn to that part from where it was affected. And for this reason when we bump into something we immediately draw our eyebrows together (αὐτίκα τὰς ὀφρῦς συνάγομεν), when the *hēgemonikon* swiftly assigns sensation to the part that has been struck, and we sometimes swallow our breath, and if our limbs are held by bonds, <...>, we press hard with our hands, obstructing the transmission of the affection and compressing the blow in the parts that are without sensation, so that it should not, by reaching the intelligent part, become pain.

In the context of this list, the physical phenomenon observed in connection with the eyebrows does not appear to be privileged or regarded as any more significant than those connected with breathing or squeezing with the hands. All of these examples appear intended to illustrate how, when we are struck, we instinctively try to disrupt the continuity between the affected part and the part of the body in which stimuli are registered and become perceptions. So we would expect all these phenomena to concern locations somewhere *between* the affected part and the central location. If the central part compressed itself, it would be too late for the stimulus to be prevented from reaching it. The possibility should be taken seriously that Strato was merely elaborating, and providing further support for, Aristotle's view that sensation properly occurs only in the common sensorium (in the heart).⁷⁸

Several other Stratonian testimonia on the soul show interest in the same issue. The *Placita* elsewhere records that 'Strato [says that] the emotions of the soul too, and the sensations, have their being in the *hēgemonikon* and not in the places that are affected. For it is in [the soul] that they are undergone, as with fearful and painful things'.⁷⁹ In his *On the Intelligence of Animals*, Plutarch argues against the Stoic denial that animals are intelligent or rational beings. He takes it that pursuit or avoidance of the objects of sensation requires the rational functions of calculating, judging, remembering and so on. If animals were irrational, they would be unable to pursue or avoid what they perceive, and hence, in conflict with the Stoic conception of providence, Nature would have given them sensation not only pointlessly, but also cruelly, since they would actually be better off without it in the absence of rationality. Having set out this argument, Plutarch next brings in Strato:⁸⁰

And indeed there is an argument of Strato the natural philosopher which shows that not even sensation is present at all in the absence of mind. For frequently we fail to notice letters when we traverse them with our sight and words that fall on our ears, because we have our mind on something else; and then again (the mind) returns and runs after and pursues and gathers up each of the things that are uttered.⁸¹ This is why

⁷⁸ Arist. *Sens.* 2, 438b 9-17. See Johansen 1997: 67-95, esp. 74-94, for full discussion of Aristotle's view concerning the heart as locus of perception.

⁷⁹ Fr. 63A Sharples = fr. 110 Wehrli (Plut. *Plac.* 4.23).

⁸⁰ Fr. 62 Sharples = fr. 112 Wehrli (Plut. *Soll. Anim.* 960E-961A), after Sharples, καίτοι Στράτωνός γε τοῦ φυσικοῦ λόγος ἐστὶν ἀποδεικνύων ὡς οὐδ' αἰσθάνεσθαι τὸ παράπαν ἄνευ τοῦ νοεῖν ὑπάρχει· καὶ γὰρ γράμματα πολλάκις ἐπιπορευομένους τῇ ὄψει καὶ λόγοι προσπίπτοντες τῇ ἀκοῇ διαλανθάνουσιν ἡμᾶς καὶ διαφεύγουσι πρὸς ἐτέροις τὸν νοῦν ἔχοντας· εἴτ' αὐθις ἐπανήλθε καὶ μεταθεῖ καὶ διώκει τῶν προἰεμένων ἕκαστον ἀναλεγόμενος· ἢ καὶ λέλεκται, "νοῦς ὀρῆ καὶ νοῦς ἀκούει, τᾶλλα κωφὰ καὶ τυφλά," ὡς τοῦ περὶ τὰ ὄμματα καὶ ὄτα πάθους, ἂν μὴ παρῆ τὸ φρονοῦν, αἰσθησὶν οὐ ποιοῦντος.

⁸¹ Sharples translates τῶν προἰεμένων ἕκαστον as 'each of the things that it cast away'. For προἰεμαί in the sense of 'utter' when used of sounds, which I prefer here, see *LSJ*⁹ s.v. B I 2.

it is said that ‘Mind sees and hears, the rest are deaf and blind’, since the experience in the eyes and ears does not produce sensation if what thinks is not present.

Given Strato’s reliance on phenomena associated with reading and listening to spoken discourse (λόγοι), he can hardly have been talking about animals in the original context from which this testimonium was taken. Taken by itself, Strato’s argument seems to point in the same direction as the one we have just been looking at, using evidence from everyday experience to support the notion that a common sensorium is needed to turn external stimuli into true perceptions: whereas he focused on phenomena associated with pain before, here he adduces the registering of meaning in rational discourse. Plutarch believes that Strato’s argument works against the Stoics in that, since perception cannot occur without the intellective faculty, and since animals have perception, they must also have the intellective faculty and therefore must be rational. But there is no reason to think that Strato believed that all animals have to be rational: in this case, he has evidently just selected human experiences as examples, and we should not conclude that he thought animals could read or talk. Again, it looks as if he is just interested in the common sensorium as the true locus of perception. All this ties in well with an additional report that he likened the sense-organs to openings through which the soul peeps out, an idea that is interestingly picked up by Lucretius.⁸²

Again, I suggest the possibility that a Stoic discussion, framed in terms of an account of the *hēgemonikon*, was the source for the *Placita* entry on Strato concerning the space between the eyebrows. The idea that the true locus of perception is not the sense-organ in which the stimuli are received, but a central location where the stimuli are actually registered, is of course shared by the Stoics. In fact, this Stoic view is recorded elsewhere in the *Placita*, at 4.23, just before the entry on Strato and the location of the emotions and sensations in the *hēgemonikon* mentioned above.⁸³ On my account, this is no accident: the Stoic source will have borrowed Stratonic arguments, but only for the conclusion that it is properly not the sense-organs that perceive, but the central location in which they are registered. A later doxographer, reading the Stratonic argument in a Stoic framework, and searching (because of that Stoic framework) for *doxai* regarding the location of the *hēgemonikon*, mistakenly picked up on the mention of the space between the eyebrows, and jumped to the wrong conclusion. This is just the sort of thing that I suggest happened to Herophilus and Erasistratus, and once again Chrysippus’ *On the Soul* seems an eminently plausible candidate for this source.⁸⁴

⁸² Fr. 61 Sharples = fr. 109 Wehrli (S.E. M. 7.348-50); cf. fr. 59 Sharples = fr. 108 Wehrli (Tert. DA 14.3-5). Lucretius argues against the view at 3.350-69, without naming Strato.

⁸³ Ps.-Plut. *Plac.* 4.23, Περὶ παθῶν σωματικῶν καὶ εἰ συναλγεῖ τούτοις ἡ ψυχὴ. οἱ Στωικοὶ τὰ μὲν πάθη ἐν τοῖς πεπονθόσι τόποις, τὰς δὲ αἰσθήσεις ἐν τῷ ἡγεμονικῷ (‘On bodily affections and whether the soul shares in suffering these. The Stoics [say that] the affections [take place] in the affected places, but the sensations [take place] in the *hēgemonikon*’). Strato’s compatible view (fr. 63A Sharples = fr. 110 Wehrli) is then listed after the contrasting Epicurean one.

⁸⁴ I am very grateful to all participants at the Symposium for discussion, especially Sylvia Berryman, Gábor Betegh, Charles Brittain, Katerina Ierodiakonou, Brad Inwood, Jaap Mansfeld, David Sedley, Teun Tieleman and John Wynne. Sincere thanks are also due to Orly Lewis and Geoffrey Lloyd for comments and criticism on various aspects of earlier versions of this paper.

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